

in scope. While claims 5 - 7 originally depended from claim 1, they inherently included the features of original claim 3, so they have been amended so as to depend from amended claim 3 and therefore remain unchanged in scope from their original form. The amendments to claims 3 and 5 - 7 thus merely represent a regrouping of the claims and are unrelated to issues of patentability.

Claim 2 was objected to under 37 CFR 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim. Specifically, according to the Official Action, claim 2 fails to further limit claim 1.

This objection is respectfully traversed because claim 2 does indeed further limit claim 1. Claim 1 states that a solder paste includes a plurality of different types of metal powder mixed with a flux, one of the metal powders being a Sn alloy powder, another of the metal powders being selected from a Sn alloy powder, elemental Ag powder, elemental Cu powder, and elemental Sn powder. Claim 2 states that one of the metal powders of claim 1 comprises an elemental metal powder of Ag, Cu or Sn. These two claims are clearly of different scope, because claim 1 could be infringed by a product which includes either an alloy powder or an element powder as "another of the metal powders", whereas claim 2 requires that one of the metal powders be an elemental powder. In other words, in claim 1, an elemental powder is not required for infringement, whereas in claim 2, an elemental powder is required for infringement. Thus, as claim 2

further limits claim 1, it is a proper dependent claim. The objection to this claim is therefore believed to be incorrect.

Claim 5 was objected to because of a misspelling. The Examiner is thanked for noticing this informality, which was inadvertently overlooked by the Applicants. The misspelling has been corrected, thereby overcoming the objection. This amendment is in no way related to issues of patentability.

Claims 1 - 12 were rejected under 35 USC 112 as indefinite. According to the Official Action, claim 1 sets forth a broad range and a narrow range for the same components. This rejection is respectfully traversed.

Claim 1 states that a lead-free solder paste includes a plurality of different types of metal powder mixed with a flux. It further states that one (i.e., at least one) of the metal powders is a Sn alloy powder. It also states that each Sn alloy powder includes 0 - 8 mass % of Ag, 0 - 5 mass % of Cu, and at least 80 mass % of Sn. It then states what the composition of the plurality of metal powders would be if melted. The numeric ranges stated in the claim therefore describe two distinct properties. One describes the composition of each individual Sn alloy powder, and the other sets forth the composition of the metal powders as a whole. There could be a basis for the rejection under 35 USC 112 only if the claim were describing a broad range and a narrow range for the very same parameter, but this is clearly not the case in claim 1. The rejection under 35

USC 112 is therefore inappropriate.

Claims 1 - 2, 7, 8, and 12 were rejected under 35 USC 102(b) as anticipated by Paruchuri et al (US Patent No. 5,928,404, referred to below as Paruchuri). This rejection is respectfully traversed.

Amended claim 1 describes a lead-free solder paste including a plurality of metal powders having a composition when melted of 1 - 5 mass % Ag, at least 0.5 and less than 3 mass % Cu, and a remainder of Sn. Amended claim 1 is supported by page 8, lines 19 - 23 and page 11 (Table 1) of the application as filed, which give examples of solder pastes with a plurality of metal powders having a composition when melted containing less than 3 mass % Cu. Paruchuri does not disclose or suggest such a composition.

Paruchuri states in column 3, line 64 that Cu represents 3 - 10% of the total metal weight of its solder paste, and in the Examples of Paruchuri, all of the pastes have a Cu content of 5.5 wt % or above. There is no contemplation in Paruchuri of lowering the Cu content to below 3%, as set forth in amended claim 1.

Therefore, as Paruchuri does not disclose or suggest the composition set forth in amended claim 1, it cannot anticipate this claim or render it obvious. Claim 1 and claim 2 which depends from it are therefore allowable.

Claims 7, 8, and 12 have been amended to depend from claim 3, which describes a solder paste including two Sn alloy powders. There is no disclosure or suggestion in Paruchuri of such a

solder paste. Paruchuri discloses a solder composition including a primary powder in the form of an Sn alloy and an additive powder in the form of an elemental metal, such as elemental Ag, Cu, Ni, or Bi. There is no contemplation in Paruchuri of a solder paste containing more than one Sn alloy powder. This is clear from Table 1 in column 5 of Paruchuri, in which all of the Examples employ an elemental metal powder as the additive powder.

Accordingly, since Paruchuri does not disclose or suggest a solder paste including two Sn alloy powders as set forth in claim 3, it cannot anticipate this claim or render it obvious. Claim 3 and claims 7, 8, and 12 which depend from it are thus allowable.

Claims 1, 3, and 8 - 10 were rejected under 35 USC 102(b) as anticipated by Anderson et al (US Patent No. 5,527,628, referred to below as Anderson '628). This rejection is respectfully traversed.

Claims 1 and 3 each describe a solder paste including a plurality of different types of metal powder, and claims 8 - 10 describe a method using a solder paste including a plurality of different types of metal powder for reflow soldering. Anderson '628 discloses a ternary eutectic Sn-Ag-Cu solder. Column 5, line 62 of that patent states that the solder can be in the form of a solder powder, but there is no mention whatsoever of a paste including a plurality of different types of metal powder. In fact, it is clear that when the solder of Anderson '628 is in the form of a powder, it is in the form of a single type of powder. For example, column 6, line 23 of Anderson '628 states that HPGA

solder powder can be made from a prealloyed ingot, which necessarily results in a single type of powder.

Thus, as Anderson '628 does not disclose a solder paste including a plurality of different types of metal powder, it does not include all the features of claim 1 or claim 3, so it cannot anticipate these claims. Furthermore, since it does not disclose a solder paste including a plurality of different types of metal powder, it does not disclose or suggest a soldering method using such a solder paste, so it cannot anticipate method claims 8 - 10. Claims 1, 3, and 8 - 10 are therefore allowable.

Claims 4 - 7 were rejected under 35 USC 102(b) as anticipated by Anderson '628 or alternatively under 35 USC 103(a) as obvious over Anderson '628. This rejection is respectfully traversed.

Claims 4 - 7 have been amended to depend from claim 3. As explained above, Anderson '628 does not anticipate claim 3, so it is impossible for it to anticipate dependent claims 4 - 7.

The obviousness rejection appears to be deficient on its face. The rejection fails to point out the differences between the prior art and the claims, it fails to provide any teachings to make up for the deficiencies of the prior art, and it fails to show any motivation to modify the prior art in light of such teachings. In short, the rejection lacks all of the elements required to set forth a prima facie case of obviousness and is thus improper. Claims 4 - 7 are therefore allowable.

The Applicants respectfully disagree with the statement on

page 5 of the Official Action that the solder paste of the present claims is claimed as a product by process. In the phrase in the claims "a plurality of different types of metal powder mixed with a flux", the word "mixed" is used as an adjective to describe a physical state of the metal powder and the flux, and it is not used to describe a process by which that mixed state is achieved. Similarly, the clause "the plurality of metal powders having a composition when melted" does not mean that the solder paste is melted as claimed. Rather, it states what the composition of the paste would be were the paste melted, and is merely a convenient way of expressing the overall composition of all the metal powders in the paste. This fact is emphasized by claim 12 as filed, which describes printing the solder paste of claim 1 on a printed circuit board. A paste would not normally be printed in a molten state.

In the state in which the solder paste is claimed, it includes a plurality of different types of metal powder mixed with a flux. These different metal powders are present in the solder paste as distinct entities from each other and can be differentiated from one another by observation. Thus, they are not merely components used to prepare the solder paste, they are distinguishable components of the solder paste in the state claimed.

In comparing the claims with the prior art, the Examiner appears to have only considered the overall chemical composition of the solder paste. The overall composition of the metal powders is relevant to the claims, but it is not the only

limitation set forth in the claims. The presence of a plurality of metal powders in a solder paste is another physical limitation of the claims and cannot be overlooked when comparing the claims to the prior art. Thus, to be properly examined, the product claims must be construed as a composition, not as a product by process. When so construed, it is believed that the Examiner will find the claimed product to be clearly and patentably distinguished from the cited references.

Claims 9 - 11 were rejected under 35 USC 103(a) as unpatentable over Paruchuri. This rejection is respectfully traversed.

Claims 9 - 11 depend from amended claim 8, which describes a method of reflow soldering using the solder paste of claim 3. As discussed above with respect to claim 7, there is no disclosure or suggestion in Paruchuri of the solder paste described by claim 3, so Paruchuri necessarily does not disclose or suggest a method of soldering using such a paste. Therefore, Paruchuri does not suggest all the steps of method claims 9 - 11 and cannot render them obvious. These claims are accordingly allowable.

Claims 11 and 12 were rejected under 35 USC 103(a) as unpatentable over Anderson '628. This rejection is respectfully traversed.

Claims 11 and 12 depend from claim 8, which describes a soldering method using the solder paste of claim 3. As set forth in detail above, Anderson does not teach or suggest the solder

paste of claim 3, so it necessarily cannot suggest a method using such a solder paste. Claims 11 and 12 are therefore allowable.

New claims 13 - 18 describe additional features of the present invention. Claims 13 - 17 are allowable as depending from claims 1, 3, or 8. New claim 18 describes a soldering method including heating a solder paste including a plurality of different types of metal powder to melt the metal powders. As described in column 3, line 34 of Paruchuri, the additive powder used in that reference does not melt except for a certain amount of dissolution during the soldering process, whereby the unmelted particles can provide a reinforcing effect (column 6, line 39). Thus, Paruchuri teaches away from a method in which a plurality of different types of metal powder are melted during soldering. As discussed above, Anderson '628 does not disclose or suggest the presence of a plurality of different types of metal powder in a solder paste, so it is not relevant to claim 18. New claim 18 is therefore allowable.

In light of the foregoing remarks, it is believed that the present application is in condition for allowance, and favorable



consideration is respectfully requested.

Respectfully submitted,

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## ATTACHMENT A

Marked-up version of the amended claims:

1. (Amended) A lead-free solder paste including a plurality of different types of metal powder mixed with a flux, one of the metal powders being a Sn alloy powder, another of the metal powders being selected from a Sn alloy powder, elemental Ag powder, elemental Cu powder, and elemental Sn powder, each Sn alloy powder including 0 - 8 mass % of Ag, 0 - 5 mass % of Cu, and at least 80 mass % of Sn, the plurality of metal powders having a composition when melted of 1 - 5 mass % Ag, at least 0.5 [-] and less than 3 mass % Cu, and a remainder of Sn.

3. (Amended) A lead-free solder paste [as claimed in claim 1] including a plurality of different types of metal powder mixed with a flux, one of the metal powders being a Sn alloy powder, another of the metal powders being selected from a Sn alloy powder, elemental Ag powder, elemental Cu powder, and elemental Sn powder, wherein the plurality of metal powders include two Sn alloy powders, each Sn alloy powder including 0 - 8 mass % of Ag, 0 - 5 mass % of Cu, and at least 80 mass % of Sn, the plurality of metal powders having a composition when melted of 1 - 5 mass % Ag, 0.5 - 3 mass % Cu, and a remainder of Sn.

5. (Amended) A solder paste as claimed in claim [1] 3

wherein the [plurlaty] plurality of metal powders include two different Sn-Ag-Cu alloy powders.

6. (Amended) A solder paste as claimed in claim [1] 3 wherein one of the metal powders is a Sn-Ag alloy powder and another of the metal powders is a Sn-Cu alloy powder.

7. (Amended) A solder paste as claimed in claim [1] 3 wherein the plurality of metal powders include a Sn-Ag alloy powder, a Sn-Cu alloy powder, and a Sn-Ag-Cu alloy powder..

8. (Amended) A method of soldering a surface mounted device comprising performing reflow soldering using the solder paste of claim [1] 3.